medium, and to do so before it is hustled into the acceptance of some factitious brew of sounds and letters. The universal language, in fine, need not be laboriously sought for. It has been with us all the time, like a neglected tool that we have only to clean of its rust and sharpen. Let us no longer neglect it.

W. A. CASPARI.

CHEMICAL ORGANISATION IN GERMANY DURING THE WAR.

VERY soon after the outbreak of war steps were taken in Germany to organise, control, and develop the supply and manufacture of the materials necessary for chemical industry, especially that part of it most closely connected with the manufacture of munitions of war.

The first interesting sign of this internal activity was the fusion, on August 8, 1914, of the two great industrial associations, the Zentralverband deutscher Industriellen and the Bund der Industriellen, under the title Kriegsausschuss der deutschen Industrie (War Committee of German Industry).

The next step was the formation of a large number of organisations and Zentralstellen, the function of which was the collection, control, and regulated distribution of the whole existing stock of war materials and crude products necessary for industry, especially in its relation to war. Thus were formed the Kriegsmetall Aktiengesellschaft and the Kriegschemikalien Aktiengesellschaft. Before the end of 1914 no fewer than twenty-eight such Zentralstellen had been formed, each dealing with a different kind of material or product. One has also been formed in Brussels for the purpose of taking stock of, and collecting, the available material found in Belgium. It is interesting to note that the German technical journals state quite openly that the Belgian stocks improved in many respects the condition of German industry, which had been somewhat shaken at the outset.

But in spite of this centralisation of control and supply, it appears that a good many difficulties have had to be surmounted. Although large stocks of Chilian nitrate had been collected before the war, the question of the supply of nitric acid was seen to be of vital importance. It appears that the Ostwald catalytic oxidation process (improved by Haber), which had been carried on before the war by the Badische Anilin- und Sodafabrik at Ludwigshafen (and also by another company at Vilvorde in Belgium), probably on a comparatively small scale, has been very largely extended. The commercial possibility of this depends, of course, on the fact that the Badische company had already developed on an enormous scale the synthetic production of ammonia initiated by the researches of Haber and Le Rossignol.

It must not be forgotten, too, that the manufacture of nitric acid from the air had been already developed in Austria by Pauling. Possibly this or similar processes (*e.g.*, Schönherr-Hessberger) have been extended since the beginning of the war. A significant fact is that the Griesheim-Elektron Company, which had started some years ago the manufacture of nitrogen peroxide in Switzerland, greatly extended these works after the outbreak of war, and sent the product in liquid form to Germany. Nitrogen peroxide is the "raw material" for the manufacture of synthetic nitric acid. It also makes quite good "poison gas." It appears that the nitrogen peroxide was allowed to pass through easily, as, no doubt, a harmless substance like that was not of any importance.

In order to make matters quite sure, the German authorities forbade the use of nitrates in agriculture. E. Haselhoff published an extensive paper giving the relative values as manure of a large number of substitutes for nitrate. Ammonium sulphate was recommended as of equal value, especially if put relatively deep into the soil, and preferably during autumn rather than spring. The value of urea and guanidine and their compounds was also considered, and close attention was given to calcium cyanamide, which is produced in large quantities in Germany. As regards phosphates, which are so important for manure, attention was directed to the deposits in the neighbourhood of Liège and Mons, and to the phosphorites of the Rhine and Lahn districts; also to Thomas phosphate slag.

In connection with the use of calcium cyanamide, the Prussian Department of State for Agriculture issued, at the beginning of 1915, a circular asking for rapid solutions of the following problems, namely: (1) Determination of the value of calcium cyanamide as manure, at the different seasons, for different soils, and for different crops. (2) Improvements in its *Streufähigheit* (capability of being strewn or spread).

For the first, three prizes of 150*l.*, 100*l.*, and 50*l.* were offered. For the second problem a prize of 500*l.* was offered for the devising of a new process, and another prize of 500*l.* if the process be adopted.

The Germans appear to have been obliged to take great precautions to avoid a shortage of sulphuric acid. In time of peace Germany obtains about 80 per cent. of her supply from outside, mainly from Belgium, where it is obtained as a by-product in the roasting of sulphide ores (zinc, lead, iron). But this source must have been practically stopped, in spite of the occupation of Belgium, since the ores treated in Belgium come mainly from Spain, North Africa, America, and Australia. The employment of sulphur can scarcely be feasible, unless Germany has succeeded since the outbreak of war in obtaining sufficient supplies from Italy and America. Swedish ores can, however, be handled, especially by means of mechanical roasters. There are also the Norwegian, Hungarian, and Styrian ores to be reckoned with. There are, however, many evidences that the employment of sulphuric acid has been put under the strictest control and supervision.

The question of substitutes for wheat and rye in the manufacture of bread has been very widely discussed. Amongst the substitutes or additions

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suggested may be mentioned barley, potatoes, blood, sugar, etc. Many prominent specialists (*e.g.*, Zuntz, Kobert, Thiele, Neumann, Stokola) have written articles discussing the relative nutritive powers of various types of "composite" bread. Besides the new factories for synthetic ammonia and nitric acid, there is evidence that factories have been installed for the manufacture of aluminium hydroxide and aluminium, but no details have been published; though it is claimed that new methods of working have surmounted the difficulty caused by the want of French bauxite.

In spite of Germany's enormous production of zinc, the refining of the crude metal had not been practised to any considerable extent before the war. It is stated that this is now an established industry in Germany.

Suggestions have been made to avoid the use of sulphuric acid in the manufacture of hydrochloric acid by producing the latter directly by the direct combination of electrolytic hydrogen and chlorine. In order to save sulphuric acid C. Bruder has proposed to extract copper from poor ores by the use of alkaline solutions.

Acetic acid is a very important substance, as it is, for example, the source of acetic anhydride, monochloroacetic acid, and acetone, which are indispensable for the manufacture of drugs, dyes, and explosives.

As the American supply of grey acetate is now failing, suggestions have been made to prepare acetic acid from acetaldehyde obtained from acetylene. There appears to be no shortage of carbide, which is still coming freely from Norway and Switzerland.

Fatty oils and fats are indispensable, and Germany is bound to obtain a large amount from abroad. The Germans have expressed their satisfaction that the fatty oils solidified by the Normann process have been allowed to pass freely in, and have commented on the "fairness" of England in this respect. Stupidity would be, perhaps, a better word. A large amount appears to enter through neutral countries. Thus, according to statistics of Norwegian trade, published by the *Chemiker Zeitung* of August 4, 1915, the export of fatty oils from Norway in 1913 was 348 tons, whereas in 1914 it had risen to 2009 tons. The shortage of fats and oils is obvious, however, from papers such as that published by Bechhold, where it is suggested that all the fats which disappear down the kitchen sinks of Germany should be recovered, the quantity being calculated to be about one and a half million pounds per diem in Germany alone.

As regards the production of hydrogen gas, no doubt for war purposes, it is interesting to note that a single firm, Karl Francke, in Bremen, has erected eight new factories since the beginning of the war, each of which has a daily output of 60,000 cubic metres (more than two million cubic feet).

During the naphtha shortage, caused by the Russian occupation of Galicia, alcohol came somewhat into use as a liquid fuel.

In connection with the use of chlorine as a poison gas, it is interesting to observe the regular appearance in the *Chemiker Zeitung*, from May 29, 1915, onwards, of an advertisement asking for the delivery of 250,000 kilos of liquid chlorine. Also in different issues of the same journal, during the month of July, 1915, there are advertisements asking for the rapid delivery of complete plants for chlorine liquefaction. Interesting also in this connection are requests for delivery of large quantities of bromides, dated December 9, 1914, and March 10, 1915. There are also requests for liquid sulphur dioxide (January 30, 1915) and liquid hydrogen chloride (April 14, 1915).

The *Chemiker Zeitung* (vol. ii., p. 738, 1915) contains a reference to an article by Prof. Leo Vignon, of Lyons, comparing the proportional numbers of chemists in Switzerland, Germany, France, and England in comparison with their respective populations. The relative numbers given are: Switzerland, 300; Germany, 250; France, 7; England, 6. No doubt the low "chemical density" in France and England is a source of undeniable satisfaction to the readers of the *Chemiker Zeitung*. The figures are certainly astonishing, and we would commend them to the attentive consideration of British chemical manufacturers. A perusal of the German journals dealing with the industrial aspects of chemistry gives the impression that there is a pretty severe censorship as regards publication, for little can be gathered concerning the most vital points.

In conclusion I desire to express my best thanks to Dr. F. Schwers, of the University of Liege, who has rendered me valuable aid in the cellection of such information as it has been possible to obtain.

F. G. DONNAN.

ECONOMIC GEOLOGY.[1]

THE exploitation of the mineral resources of this country, previous to the war, was, apart from the ordinary fluctuations due to variations in supply and demand, governed almost entirely by the cost of production as compared with that of importation. Materials required for the manufacture of many articles, in some cases even munitions of war, were bought in the cheapest market, with the result that certain minerals ceased to be worked, not because the supply was exhausted, but because they could not be produced at a profit; whilst others which had recently acquired an economic importance were not even diligently searched for.

With the outbreak of war the inconvenience of this policy became painfully manifest, and it is not surprising to learn, from the Director's preface to the first of these "special reports," that numerous inquiries were made at the Geological Survey Office as to the occurrence in Britain of various materials for the supply of which dependence had

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[1] Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. i., Tungsten and Manganese Ores. Pp. iv+50. Price 1*s*. Vol. ii., Barytes and Witherite. Pp. iv+93. Price 1*s*. 6*d*. Vol. iii., Gypsum and Anhydrite; Celestine and Strontianite. Pp. iv+57. Price 1*s*. (London: H.M.S.O.; E. Stanford, Ltd.

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